SEISMIC ARRAY ANALYSIS CENTER
QUARTERLY TECHNICAL SUMMARY REPORT
JULY - SEPTEMBER 1971

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16

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SEISMIC ARRAY ANALYSIS CENTER
QUARTERLY TECHNICAL SUMMARY REPORT
July - September 1971

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AFTAC Project Number:	VELA T/1709
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AVAILABILITY

This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of Chief, AFTAC.

Operations

During July, August, and September 1971, we operated the Detection Processor (DP-ISRSPS) routinely with the same set of system parameters used during the first quarter of 1971. These parameters include the beam deployment (300 LASA fine beams of 17 subarrays, A-ring through the E-ring, and 299 LASA coarse beams of 9 subarrays, A-ring through the C-ring), filter (0.9 to 1.4 Hz), detection logic (4 threshold crossings in 4 successive 1.8 second overlapping intervals), and detection threshold (10 db in the first interval and 7 db in the subsequent three intervals).

The following tables show the DP uptime and downtime for LASA data during the third quarter as well as the general problem categories causing the downtime. The large amount of downtime in July for the LASA Data Center (LDC) was due to a power supply failure on the 13th of the month. Table I is for the LASA data (DP-ISRSPS) only. During most of the downtimes listed LASA data was recorded either at SAAC on interim system (IISPS) or at the LASA Data Center.

DP Up-Downtime in 3rd Quarter 1971

Month	July	August	September	Total
		in hours		
Problems				
SAAC Computer Room	4.9	6.5	5.9	17.3
LASA Data Center	27.6	5.0	1.3	33.9
50 KB Phone Line	3.0	7.0	4.3	14.3
Prev. Maintenance	10.2	5.2	8.5	23.9
Total DP Downtime	45.7	23.7	20.0	89.4
Total DP Uptime	698.3	720.3	700.0	2118.6
% Uptime	93.9	96.8	97.2	96.0
Total Possible Recording Time	744.0	744.0	720.0	2208.0

Table I

DP-EP Analysis Time in 3rd Quarter 1971

	July	August	September	Total
		in hours		
DP Recording Time Covered by EP Analysis	695.6	720.3	699.1	2116.3
Analyst Time Required on the EOC	168.5	154.7	135.4	458.6
IBM 360/40B Time Required for EP	550.0 (estimated)	537.0	499.0	1586.0
No. of Detections	15351	14070	12865	42286
No. of Events Listed in Daily Summary	971	786	720	2423

Table II

During this third quarter of 1971, we also operated the Event Processor (EP-ISRSPS) routinely with the same parameter settings that were in use at the end of the second quarter. Some events were being eliminated from the Daily Summary because the system mistook the velocity of the final solution as being outside the limits of the primary (P) wave. This program error was corrected on 16 August.

Long Period Processing

The necessary FORTRAN software for a preliminary evaluation of the long period capability of the large array network ~~has now~~ been completed. Long period data, taken directly from the low-rate tapes, are being routinely analyzed to build a data base for the evaluation.

All events reported over a selected period of time in the LASA Daily Summary are processed in order to detect and measure a Rayleigh wave associated with each event. In this past quarter the data from LASA and NORSAR have been used, but due to the intermittent nature of the NORSAR LP data received at SAAC, direct comparisons are not yet reliable.

Frequency domain (f-k) beamforming has proved to be very efficient in the LP analysis. A method has been developed to estimate the surface wave magnitude (M_s) directly from the wave-number power spectrum and is currently being tested against the conventional method.

Documentation and Programming

The Detection Processor ~~(DP-ISRSPS)~~ ~~has~~ been running routinely during the months of July, August, and September. No new errors have been located in the system. However, it was found that additional capabilities are needed to properly process large events.

Presently, when a large event occurs the DP system notifies the EP system by sending a message across a channel-to-channel interface between the two 360/40 computers. The EP system accepts the message and flags that detection in the Signal Arrival Queue (SAQ) as one to be examined under the criteria set up for large events (namely, using the padded seismometers). However, when the EP system is not running, usually from 6 to 8 hours per day, this procedure does not work. Currently, those

large events which occur when EP is down are processed as normal events. Thus, they are often clipped. DP needs the capability to set a flag in the Signal Arrival Queue (SAQ) whenever large events occur, whether EP is up and running or temporarily down. Then all events flagged as large events by DP will be processed as large events by EP.

In planning our D-ring deployment test, we discovered that the DP support programs which build the IISPS core image tapes were not functioning properly. After one man-month of effort, the program now appears to be correct. Although the errors in the programs did not effect the on-line system, they did delay SAAC plans for off-line DP testing. Now, off-line testing of various DP parameter sets will begin shortly.

The third set of changes were installed on the on-line EP system. These modifications were to correct the following problems:

1. velocity failures claimed when in fact the velocity was well within the velocity range for a given phase;

2. a tape rewind problem in job step 4 which caused additional search time for a given event;
3. event data sets not being released when reruns are cancelled;
4. a coding error in the EP priority logic;
5. an error in EP which caused event tapes to be written without the first file being a common file.

In addition to the above, there is an error in the EP beam packing routine (used to achieve event location). We are running tests currently to find the error and correct the problem.

Additional support programs were required to expand SAAC capabilities. An ALPA to FFASTRO conversion program was released to SAAC in June. However, it did not function properly. Because of design shortcomings as well as the extensive debugging required, we decided to write our own ALPA to FFASTRO program. That program is completed and has been supplying users with ALPA LP data in the FFASTRO format for almost two months.

During the month of June, SAAC began receiving NORSAR event data as a part of the NORSAR record sent to SAAC via the Trans-Atlantic Link. In order to get this data to users as soon as possible, SAAC developed a support program to scan the low rate tapes and produce a tape containing most of the NORSAR event data, and print the NORSAR seismic bulletin. The tape is received by mail. This program is run every week-day morning in order to provide the NORSAR Bulletin to interested persons as soon as possible.

SAAC has completed the upgrading of the 360/44 DOS to release 25, and installed job accounting. Job accounting will aid SAAC in accurately recording the computer time usage and provide guidelines for improved system through-put.

Most of the Application Programming Reports have been delivered by IBM to SAAC. From our experience in the past, we feel that many of these programs will not function properly. Thus, we are studying and testing those programs most pertinent to the SAAC operation.

Most of the SAAC documentation has been delivered. A list of documentation completion dates have been obtained from IBM. This has enabled SAAC to begin constructing the first set of updates for SAAC documentation.

<u>Data Requests</u>

During the past quarter we solved our format conversion problems and began supplying data to Lincoln Labs in their requested format. A total of 391 tapes have been prepared for Lincoln Labs. Only 150 data requests remain to be filled.

We have supplied a total of 80 ALPA, NORSAR and LASA tapes to SDL during the past quarter. There are 24 more requests for NORSAR SP data which are waiting for tapes from Norway.

SAAC Evaluation

During the third quarter of 1971, we published Technical Report No. 1, "Evaluation of the SAAC/LASA System." This report is an evaluation of the SAAC automated data acquisition and processing systems as developed by the Federal Systems Division of IBM contracts F19628-67-C-0198 and F19628-68-C-0400 and based upon our operations of SAAC on a 24-hour day, 7-day week schedule from February 1 to May 16, 1971.

The system operates in two parts. The Detection Processor performs data acquisition and signal detection. The Event Processor is designed to recognize true signals and false alarms and to extract event parameters, refine locations, and publish an earthquake bulletin. The Event Processor is programmed to work either in an automated mode in which the computer analyzes events and publishes the bulletin without help from a seismic analyst, or to act as an aide to the analyst who can edit the event processing on a display console.

The Detection Processor works well as a data acquisition, recording, and signal detection system. System parameters such as filters, beam composition and deployment, detection thresholds, and detection logic are adjustable over satisfactory limits. Marginal improvements are possible in the detection processing. Improvement in system reliability beyond its present 90 to 95% will depend first upon improvement in the reliability of the 50 kilobit phone line between LASA and SAAC.

The Event Processor with analyst editing is able to handle the data output from LASA and produce an acceptable seismic bulletin within 24 hours. The LASA Daily Summary lists an average of 30 events per day excluding local earthquakes at a signal-to-noise ratio of five, mostly at distances of 30° to 100° from LASA. The system can be improved in its handling of local events and very large events.

The Event Processor cannot work reliably in the automated mode. As compared to analyst measurements, its false signal rate and missed signal rates are too

high; its refinement of location offers little or no improvement over detection beam location; and its estimates of event parameters, especially arrival time and depth estimates, are unreliable. Consequently the outputs from automated LASA/SAAC cannot be used for accurate locations and depths by a precision seismic network.